Amendments to the Specification

The paragraphs starting at page 1, line 14 and ending at page 2, line 8 have been amended as follows.

A known recording head described in Japanese Patent Laid-Open No. 2002-79672 includes two nozzle rows, each row including a plurality of nozzles aligned at a regular pitch, and an ink inlet provided between the nozzle rows. By providing nozzles on both sides of the ink inlet so that nozzles in one nozzle row are offset by a half pitch from the nozzles in the other nozzle row, the nozzle density of ~~in~~ a known recording head having such a structure is two times the nozzle density of a recording head including only one nozzle row.

Fig. 1 is a perspective plan view illustrating the inlets and their periphery of a known recording head. As illustrated in Fig. 1, on both sides of an ink inlet 1500, a plurality of outlets 1100 are aligned at a predetermined pitch in the longitudinal direction of the ink inlet 1500 (i.e., the vertical direction in the drawing). The ink inlet 1500 communicates with nozzles that each ~~includes~~ include one of the outlets 1100 and an ink channel 1300. In this way, ink is supplied from the ink inlet 1500 to each of the outlets 1100.

The paragraph starting at page 5, line 4 and ending at line 8 has been amended as follows.

The difference in the channel resistance also ~~cause~~ causes a difference in the discharge performance of the outlets. A significant difference in the discharge performance of each outlet may cause a decrease in image quality.

The paragraph starting at page 8, line 13 and ending at line 15 has been amended as follows.

Fig. 9 is a block diagram illustrating the circuitry in which both a driving pulse and a driving ~~pulse~~ voltage are divided.

The paragraph starting at page 10, line 11 and ending at page 11, line 3 has been amended as follows.

The recording head 101 having such a structure is aligned and fixed on an ink supplying member 150 having ~~a~~ an ink channel (not shown) for supplying ink to the common liquid chamber 112 in the Si substrate 110. When the recording head 101 is ~~at~~ in use, it operates as described below. First, a voltage applied to the recording elements 400 from outside via electrical wiring (not shown) causes the recording elements 400 including heating resistors to radiate heat. The thermal energy causes the ink inside the ink channels 300 to boil. The bubbles generated by this boiling pushes the ink in the ink channels 300 out from the outlets 100 as ink droplets. The recording head 101 having such a structure carries out the above-described

operation while the upper surface of the channel-forming member 111, i.e., the outlet surface, opposes a recording medium, such as paper. As a result, the discharged ink droplets are applied to the recording medium to form an image on the recording medium.

The paragraph starting at page 12, line 11 and ending at line 10 has been amended as follows.

The pitch p is set so that the outlet density of the outlet group 900 is 1,200 dpi. Since, as described above, the outlet groups 900a and 900b are offset by a half pitch (p/2), the resolution of the entire recording head 101 is 2,400 dpi. According to this embodiment, the volume of each ink droplet discharged from each of the outlets 100 is 1 pl. The sizes of the components and the ink droplet volume suitable for ~~obtain~~ obtaining the above-mentioned resolution will be described in detail below.

The paragraphs starting at page 15, line 22 and ending at page 17, line 12 have been amended as follows.

When the outlets 100a and 100b are disposed in a highly dense manner in a staggered pattern, the length of the second ink channels 300b becomes relatively longer. As a result, the ink refilling time may be extended and/or the discharge from the second outlets 100b may become unstable. Therefore, according to this embodiment, the discharge from the second outlets 100b is stabilized by taking two different countermeasures as described below. The first countermeasure taken is to set the area defining each of the second recording elements 400b

smaller than the area defining each of the first recording elements 400a. Another countermeasure taken is to set the aspect ratio of the outer shape of the second recording elements 400b smaller than the aspect ratio of the outer shape of the first recording elements 400a so that each of the second recording elements 400b is substantially of a square shape .

These countermeasures will be described in detail below.

To maintain the discharge balance between the first outlets 100a and the second outlets 100b, the discharge performance of the nozzles provided ~~at the~~ further away from the ink inlet 500 (i.e., the nozzles including the second outlets 100b) may be improved. Furthermore, the aspect ratio of each of the heating resistors may be set close to 1 (i.e., the shape of the heat resistor may be substantially a square). The discharge is stabilized by reducing the aspect ratio of each of the second recording elements 400b because of the following reason. For the recording elements 400a and 400b, the temperature at their peripheral areas is lower than the temperature at their centers. Thus, the peripheral areas of the recording elements 400a and 400b do not contribute to the boiling of the ink. Therefore, when the rectangular first recording elements 400a are compared with the substantially square second recording elements 400b, the area contributing to the boiling of the ink with respect to the entire area of the recording element is relatively larger for the second recording elements 400b compared to the first recording elements 400a. In other words, the second recording elements 400b are capable of effectively transferring discharge energy to the ink.

The paragraph starting at page 19, line 25 and ending at page 20, line 25 has been amended as follows.

More specifically, since the recording elements 400a and 400b include heating resistors, the heating value of the recording elements 400a and 400b is determined in accordance with the resistance and the heating value per unit area of the material of the resistive layer 700. The resistance of the recording elements 400a and 400b is determined in accordance with the shape of the recording elements 400a and 400b. The resistance of the recording elements 400a and 400b having the structure shown in Figs. 6A, 6B and 6C becomes greater as the length of the recording elements 400a and 400b in the flow direction of the electrical current (i.e., the horizontal direction in Figs. 6A, 6B and 6C or the width of the ink inlet 500) increases. In other words, resistance becomes greater as the ratio of vertical length to the horizontal length of the recording elements 400a and 400b becomes greater, where the vertical length is equal to the width of the ink inlet 500. Therefore, when the same driving voltage and the same driving pulse are applied to both the recording elements 400a and 400b, the amount of energy supplied to ~~the~~ recording elements 400a and 400b may be ~~excess~~ excessive or ~~short~~ insufficient. As a result, the discharge performance of the recording elements 400a and 400b will vary. ~~To apply~~ In applying the same driving pulse to ~~the~~ both recording elements 400a and 400b, both ~~the~~ recording elements 400a and 400b are driven based on the same driving time.

The paragraph starting at page 21, line 16 and ending at page 22, line 14 has been amended as follows.

The circuitry shown in Fig. 7 includes a processing block 630, a plurality of terminals 620a to 620n, an electrical power supply terminal 610, a ground (GND) terminal 611, power transistors ~~(driver)~~ (drivers) 650, a first driving time determining signal terminal 600, a second driving time determining signal terminal 601, first AND circuits 640a, and second AND circuits 640b. The processing block 630 is configured to control processing of various data and time-division driving. The plurality of terminals 620a to 620n are connected to the processing block 630 and send clock (CLK) data, image data, and data related to time-division driving to the processing block 630. The electrical power supply terminal 610 supplies a driving voltage to the recording elements 400a and 400b. The circuitry includes power transistors ~~(driver)~~ (drivers) 650 ~~is~~ configured to switch the power distribution to each of the recording elements 400a and 400b. The first driving time determining signal terminal 600 determines the driving time of the first recording elements 400a. The second driving time determining signal terminal 601 determines the driving time of the first recording elements 400b. The outputs of the first AND circuits 640a and the second AND circuits 640b are connected to the power transistor 650.

The paragraph starting at page 24, line 26 and ending at page 25, line 2 has been amended as follows.

Figs. 10A and 10B are ~~a perspective~~ plan ~~view~~ views of ~~an~~ outlet ~~surface~~ surfaces of ~~a~~ recording ~~head~~ heads according to a second embodiment and illustrate recording elements and their periphery.

The paragraph starting at page 28, line 2 and ending at page 29, line 1 has been amended as follows.

The discharge amount also depends on the area of the heating resistor. However, since the width of the heating resistor is limited because of the above-described restrictions, the maximum discharge amount of the large outlets 100a disposed closer to the ink inlet 500 is about 2 pl. The maximum discharge amount of the small outlets 100d disposed further away from the ink inlet 500 is about 1 pl and the preferable amount of the small outlets 100d is about 0.6 pl because of the width of the ink channel 300d to the small outlet 100d. If the discharge amount of the large outlets 100a disposed closer to the ink inlet 500 is set to about 1 pl, the discharge amount of the small outlets 100d disposed further away from the ink inlet 500 may be less than about 0.6 pl. However, if the discharge amount is significantly small, the accuracy of the droplets landing at target areas is ~~reduces~~ reduced. Therefore, a discharge amount of about 0.6 pl is appropriate. Accordingly, in this embodiment, if the discharge amount of the small outlets 100d disposed further away from the ink inlet 500 is set between 0.4 to 1.0 pl, allowing for a margin of error, the contrast between the image recorded by the large outlets 100a and the small

outlets 100d is maintained and the discharge characteristics for each nozzle ~~is~~ are stabilized regardless of the length of the ink channels.